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Fourteenth day of January 2004

J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
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CHRISTOPHER MAX MODRA

FORM 9

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PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED:

"A LASER CUTTING APPARATUS"

This invention is described in the following statement:

A LASER CUTTING APPARATUS

TECHNICAL FIELD OF THE INVENTION

THIS INVENTION relates to a laser cutting apparatus for cutting sheet materials, and in particular but not limited thereto, the laser cutting apparatus is configured to cut patterned fabrics for blinds.

BACKGROUND OF THE INVENTION

Laser generating devices have been used in many cutting applications. In general, in these devices a focussed laser beam is directed onto a sheet material to be cut and is controlled to travel in a path over the material. The path describes a trajectory which corresponds to the desired cutting profile. For a blind or any other shaped product, the cutting profile may include a desired pattern. Thereby, the material is cut into a patterned profile determined by the travel path. As the laser beam generates a substantial heat in cutting, smoke and fumes are produced during the cutting operation. The cut material can be stained by the smoke and fumes. The stained materials cannot be used in a good quality product and therefore, there is a considerable waste in the production of laser cut sheet materials. The applicant has estimated that in the production of laser cut fabrics for blinds only about 85 percent of the cut fabrics are useable as the remainders are damaged by smoke stain.

The sheet material to be cut must held down on a bed during the cutting operation. Clamps or plastic films have been employed for this purpose. Both the clamps and the plastic films are manually applied to the sheet material.

Accordingly, the use of these articles for holding a sheet material does not allow a full automated cutting process of sheet materials.

The cut sheet material has a trim around the desired cut panel. The trim and the cut panel must be removed from the cutting station by separate actions. While any of them remains in the cutting station, a new sheet material can not be positioned in the cutting station for a cutting operation. Accordingly, the separate actions needed to remove the trim and the panel of a cut sheet material present a delay in the recommencement of cutting operations.

The trim and the cut panel are usually pickup by a clamping device. As the trim and the cut panel lie flat on the bed, a part of the clamping device must be positioned under them before a clamping action. The applicant has observed that when positioning the part of the clamping device under the term or cut panel, the material may not be completely flat when it is under a clamping action. As such, the material may be unnecessarily folded and would have to be discarded.

Some cut panels require creases to be formed thereon so as to allow folding about the crease lines to form a desired pattern. The action to impart creases is done as a separate operation at a location outside the cutting zone. Again, for this reason a full automated process is hindered.

OBJECT OF THE INVENTION

An object of the invention is to substantial alleviate or to reduce to a certain level one or more of the prior art disadvantages.

SUMMARY OF THE INVENTION

In one aspect therefore the present invention resides in a laser cutting apparatus for cutting sheet materials. The apparatus includes a bed having a top surface for a sheet material to be positioned thereon, a gantry being arranged to controllably travel along a first direction along the bed and extending over the bed in a second direction that is substantially transverse to the first direction, and a carriage being arranged to controllably travel along the gantry. The bed has a holding arrangement for holding the sheet material in position. A laser head is located on the carriage. The laser head has a laser nozzle and is arranged to receive a laser source and to direct a laser beam through the laser nozzle onto the bed for cutting the sheet material. A first vacuum chamber is arranged about the laser nozzle. The first vacuum has a suction opening around the laser nozzle for entraining substantial by products produced during cutting of the sheet material and for causing the part of the sheet material under the suction opening to be lifted from the top surface.

In preference, the holding arrangement includes a second vacuum chamber arranged below the bed and a plurality of through holes extending through the top surface and in fluid communication with the second vacuum chamber. Thus any by products below the sheet material is sucked into the second chamber. It is also preferred that a relatively high volume but low pressure is arranged to flow through the holes into the second chamber.

Air flows through the first and second chambers may be controlled so that there is an air gap between the suction opening and the lifted sheet material. Air is

then caused to flow through the air gap into the first chamber. This assists the entrainment of the by products to flow into the first chamber.

Controllable crease wheels may be arranged on the carriage for forming creases on the sheet material. The wheels may have a relatively large diameter or a dual edge profile.

The carriage may also have a controllable gripping device for gripping a leading edge of the sheet material for positioning on the bed. The gripping device has a plate which is pivotally movable and is arranged to pivot upwardly to clamp the leading edge when positioning the sheet material. In a gripping process, the gripping device is preferably controlled to lowered its plate on the bed and move to slide under the edge of the sheet material and then to retreat a short distance before clamping the sheet material.

The sheet material may be arranged in a roll form supported on rollers adjacent to the bed. The sheet material can be a fabric or cloth.

In another aspect therefore the present invention provides a laser cutting apparatus comprising:

1) a series of rollers on which rolls of sheet materials are placed;

2) a flat bed table on which the sheet material is laid out and which holds the sheet material in place by vacuum;

3) a gantry which is arranged to move along a direction of the table;

4) on this gantry is mounted a pick-up clamp arranged to clasp the sheet material and pulls it across the table;

5) on the gantry is also mounted a moving head and on this head a pair of rollers for forming crease lines into the sheet material; and

6) on the moving head on the Gantry is mounted a laser cutting of sufficient power to cut the sheet material.

The sheet material may include all kinds of synthetic and natural cloth as used for blinds, awnings, curtains, outdoor 'sails', shadecloth, or 'screen' cloth.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the system of the present invention can be readily understood and put in practically effect the description will now refer to the accompanying drawings which illustrate non-limiting embodiments of the present invention and wherein:-

Figures 1 and 2 are respective schematic side and plan views of a frame of a laser cutting apparatus according to an embodiment of the process according to the present invention;

Figure 3 is a schematic end view of the frame shown in Figure 1;

Figure 4 is an enlarged view of the laser head shown in Figure 3;

Figure 5 is a detailed cross-section view of the laser head and the bed of the embodiment of the apparatus according to the present invention;

Figure 6 shows an embodiment of the crease wheels for the apparatus according to the present invention;

Figure 7 shows a plan view and a side view of an embodiment of the apparatus according to the present invention;

Figure 8 shows an embodiment of the gripping device for the present invention; and

Figure 9 shows an application of an embodiment of the apparatus of the present invention for cutting a fabric cut into a pattern for a blind.

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to the drawings and initially to Figures 1 and 2, there is shown an embodiment of a frame for a bed 12 of a laser cutting device 10 according to the present invention. The bed frame 12 has a rectangular top frame portion 14 supported by spaced legs 16. Supported on the frame 12 are a main control box 18 for a computer based control equipment, a laser coolant system 20, a power supply 22, a laser generator 24, a collimator 26 for collimating the laser energy from the laser generator 24, and a series of mirror assemblies 28 for directing the laser energy to a laser head 30 (see Figure 3). As shown in Figure 4, the laser head 30 has a mirror arrangement 28 for directing the laser energy downwardly, and a lens assembly (not shown) for focussing the energy as a laser beam onto a sheet material 32 (see Figure 5) to be cut. For adjusting laser focus, a vernier type adjuster 34is provided to adjust the relative distance between the lens assembly and a laser nozzle 36. Typically, the laser beam 42 is focussed to impart maximum energy onto a top surface 40 of the the bed frame 12. The top surface 40 supports the sheet material 32 for cutting. In this case the sheet material is a fabric for making a blind.

To hold the fabric 32 to the bed surface 40, the apparatus uses the principle of high air flow through the fabric and therefore applies a downward force on the fabric 32. The support surface 40 is a hard plate with a pattern of small holes 44 in it. The holes 44 form inlet ports of a vacuum chamber 46 and are such as to allow the right volume of air flow through the plate 40. A hose 48 is connected to the chamber 46 and a suction machine (not shown) draws air through the holes 44 into the chamber 46 and out to the atmosphere. The holes 44 are sized so as to allow creasing wheels 48 and 50 (see Figures 4 and 6) travel over without damaging the

fabric 32. Otherwise, as a wheel rolls into a hole 44 and out again (ie the pinch point effect), damage to the fabric 32 is possible. The creasing wheel profile is designed such as to minimise the pinch point effect by using either a shallow angle relative to the surface of approximately 20 degrees or a dual edge profile which prevents the wheel from ever fully entering the hole 44.

The apparatus 10 has another vacuum chamber 50 around the laser nozzle 36. The vacuum 50 is connected to a vacuum pump (not shown) by means of two tubes 52 and 54. The lower end of the vacuum chamber is open and a vacuum nozzle plate 56 with apertures is supported in the opening. The vacuum chambers 46 and 50 are arranged so that the fabric 32 is held in the position as shown except for a portion under the vacuum nozzle plate 56. That portion as shown, is lifted off the surface 40 by an air stream that is flowing into the vacuum chamber 50. The differential between the air pressures in the two chambers is such that a small air gap 58 forms between the nozzle plate 56 and the fabric 32. The laser nozzle 36 also has a tube 60 connected to allow compressed air to flow into the interior of the nozzle 36 and then out therefrom. The arrangement of the two vacuum chambers eliminates smoke and heat damage to the fabric by two processes. Firstly, a stream of air jet blasts the vaporised and burnt material away from the underside of the fabric. Secondly, the vacuum in the chamber 50 around the nozzle 36 assists in drawing away smoke from the upper side of the fabric and around the cut region. The lifting of the fabric 32 from the surface 40 provides a clearance underneath the fabric32 to allow smoke and debris to disperse downwards and not bounce back up onto the fabric 32. It also draws the fabric 32 close to the vacuum chamber 50 so smoke and debris are drawn away rapidly from above by the air flow caused by

the vacuum in the chamber 50. The end nozzle plate 56 allows the laser head 30 to slide with ease over the fabric 32, in part due to a cushion effect generated by the air flow created by the vacuum in the vacuum chamber 50.

Turning to Figure 7, the laser head 30 is mounted on a carriage 62 which is movably supported on a gantry 64. Thus, the laser head 30 is arranged to move with the carriage 62 along the gantry 64 in a direction indicated as "Y". The gantry is movably supported on side rails 66 and 68 that are fixed to opposite sides of the bed frame 12. Thus the gantry 64 is arranged to move along the bed frame 12 in a direction indicated as "X". Attached to the lower part of the carriage 62 is a gripping device 70 for gripping to an end of the fabric 32 for positioning a length of the fabric 32 onto the surface 40 for cutting. A pair of rollers 72 and 74 are supported at an end of the bed frame 12 and a roll (not shown) of the fabric 32 is rotatably supported on the rollers 72 and 74.

The gripping device 70 as shown in Figure 8 has a lower pivoting plate 76and an upper plate 78 mounted to the underside of the gantry 64. To grip onto the fabric 32, the gantry 64 is controlled to proceed forward with the plate 76 pressed down on the surface 40. The fabric 32 then slides up over the plate 76. As the fabric 32 does not behave in a consistent fashion and may catch on the front edge of the plate 76, for example if the fabric is curled down even though the edge of the plate 76 is sharpened in an attempt to prevent this. The carriage 62, after having gone forward to pick up the fabric 32, then moves back a small amount of distance to allow the fabric 32 to relax, and to allow any catching to unhook, in doping so the fabric 32 flattens out over the plate 76. The plate 76 then lifts up

causing the fabric 32 to be clamped in a jaw like fashion between the upper plate 78 and the lower plate 76. The fabric 32 is then pulled out over the surface 40 of the bed frame 12 or carried to the end of the frame 12 if the cutting operation is complete.

The laser cutting operation is controlled so that the cut panel 80 remains connected to the trim around it by means by spaced links 84. Thus, the panel 80 and the trim 82 can be transferred from the surface 40 in a single operation step. The panels 80 and any trims 82 (off-cuts) remain connected to one another by a series of small links 84 typically about 1 mm wide and spread at suitable intervals so that the pieces do not break away from each other after transport of the group begins, typically at 200 mm. Separation of the cut panels 80 place by breaking the links manually, which by virtue of their small size, or by virtue of the fact that the link is partially cut by the laser (i.e. not fully through), they break apart with ease.

Whilst the above has been given by way of illustrative example of the present invention many variations and modifications thereto will be apparent to those skilled in the art without departing from the broad ambit and scope of the invention as herein set forth.

DATED this 19th day December of 2002

CHRISTOPHER MAX MODRA

By his Patent Attorneys

INTELLPRO

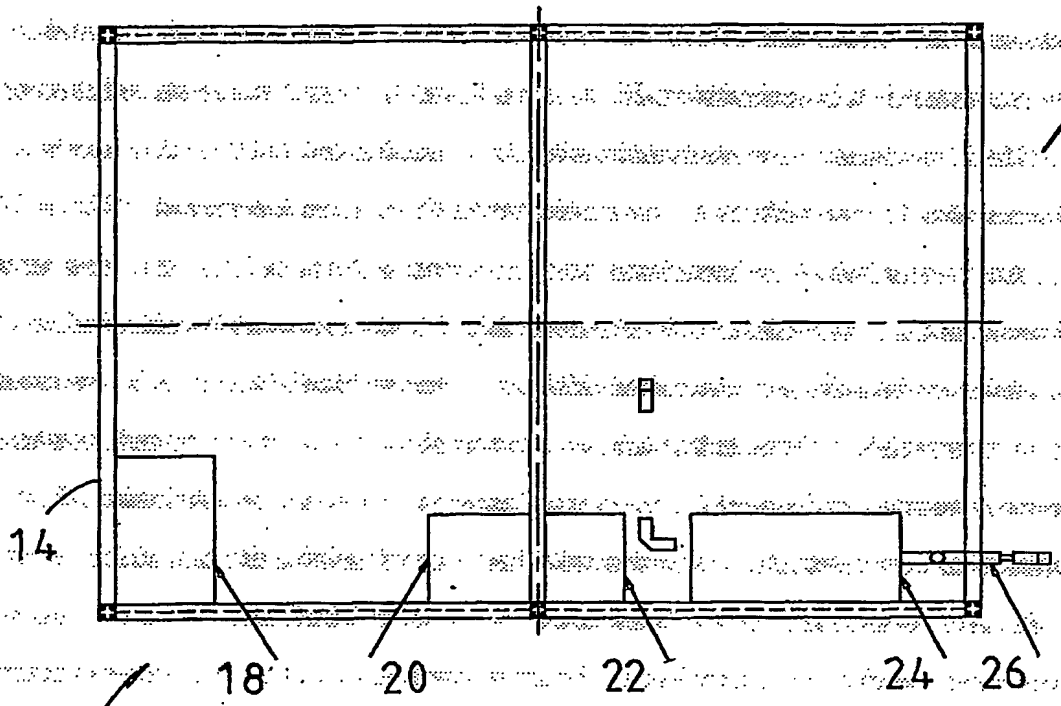

FIG. 2

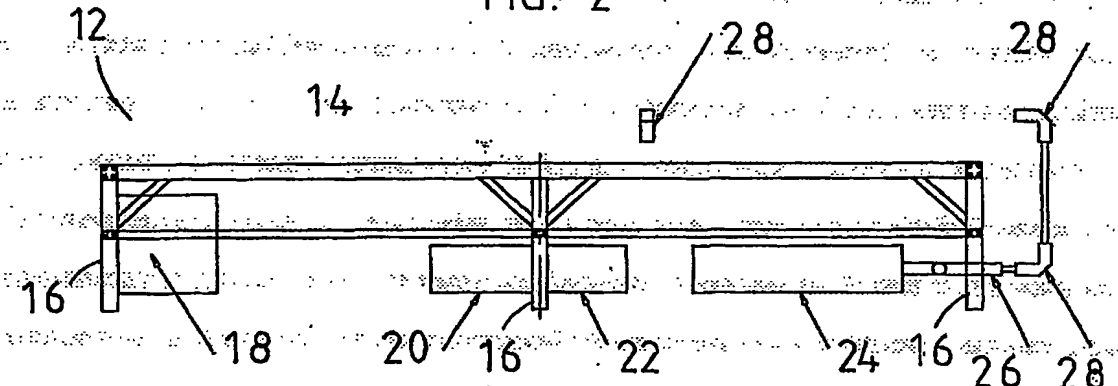

FIG. 1

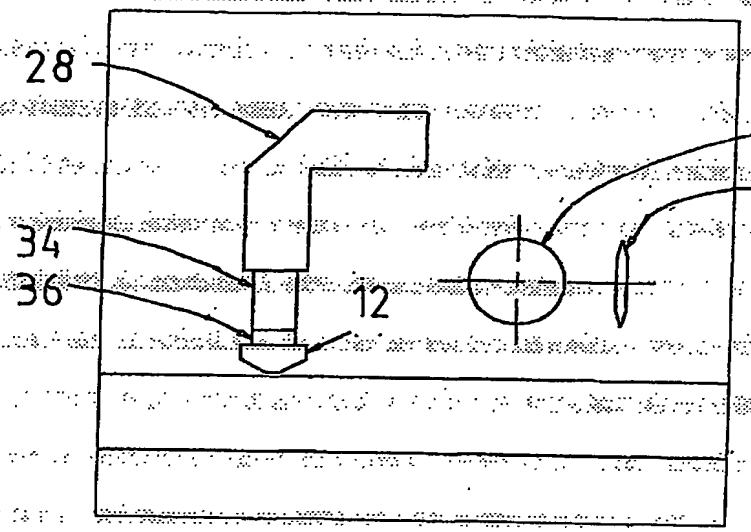

FIG. 4

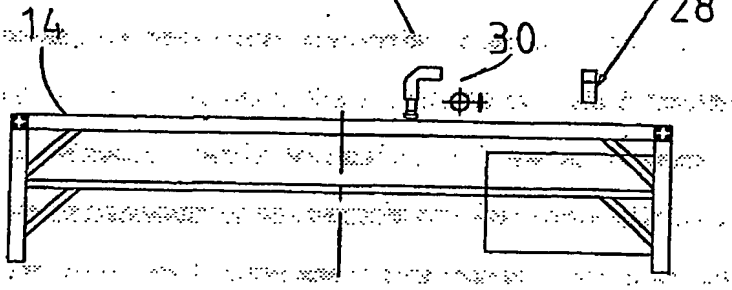

FIG. 3

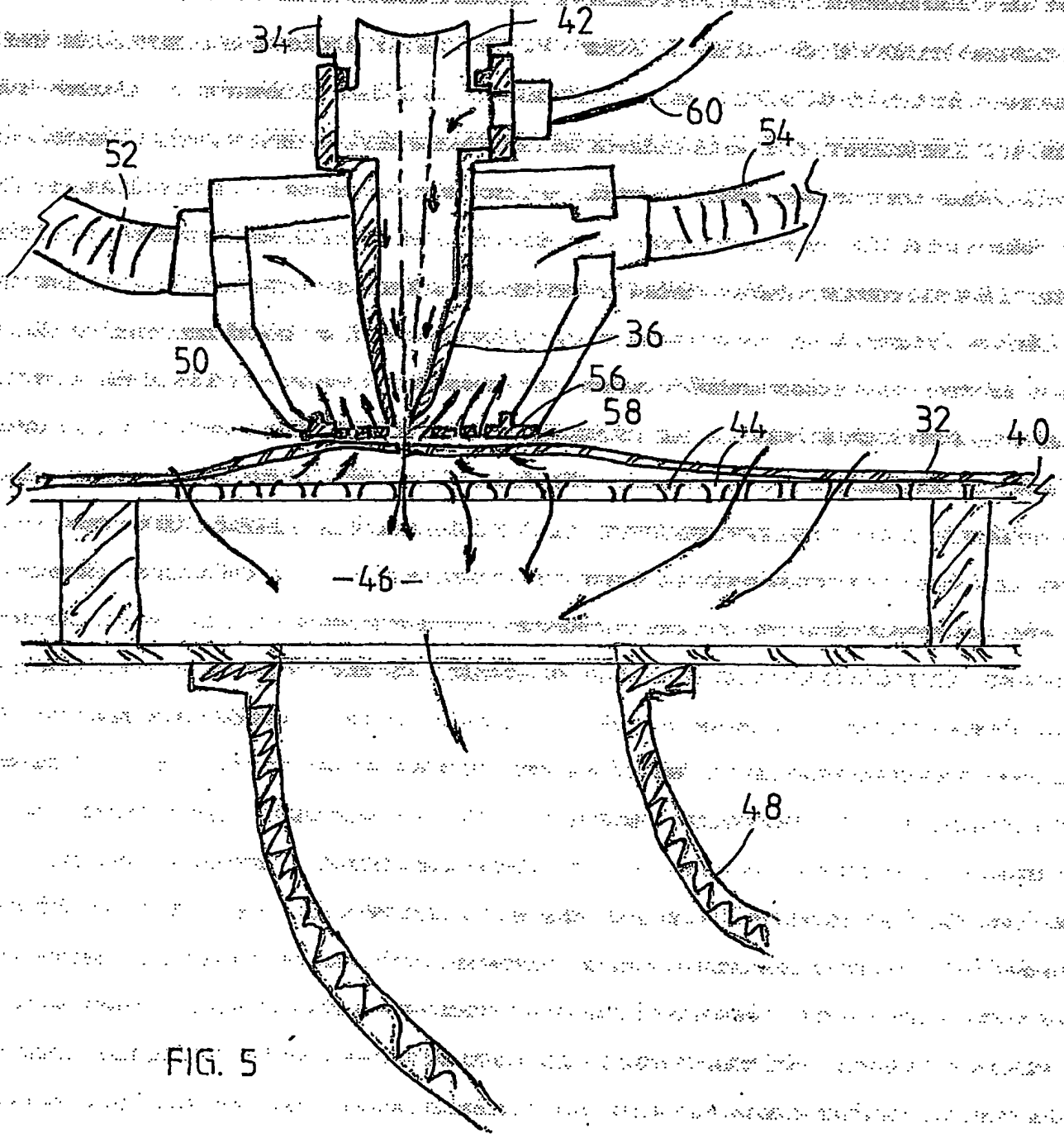

FIG. 5

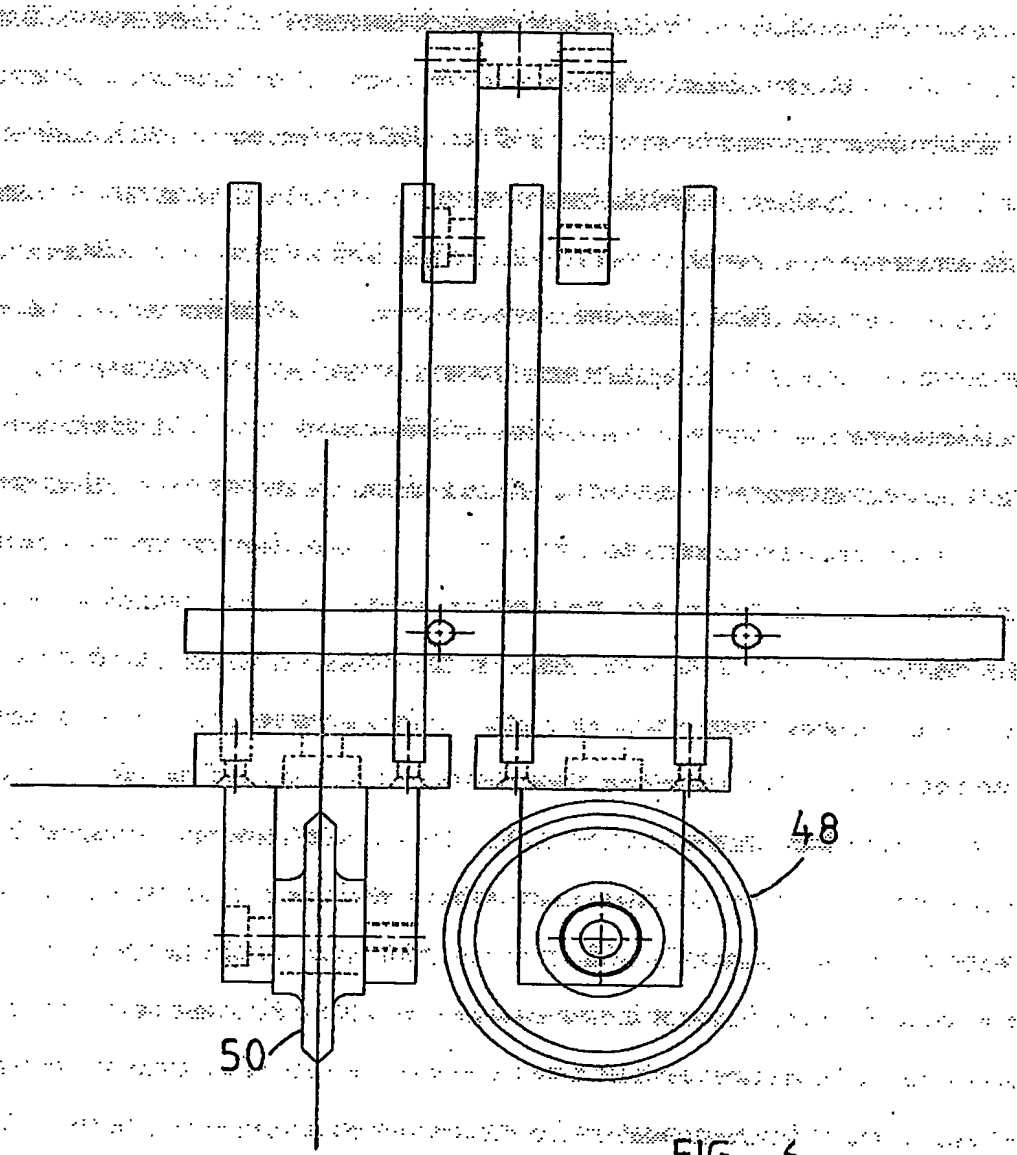

FIG. 6

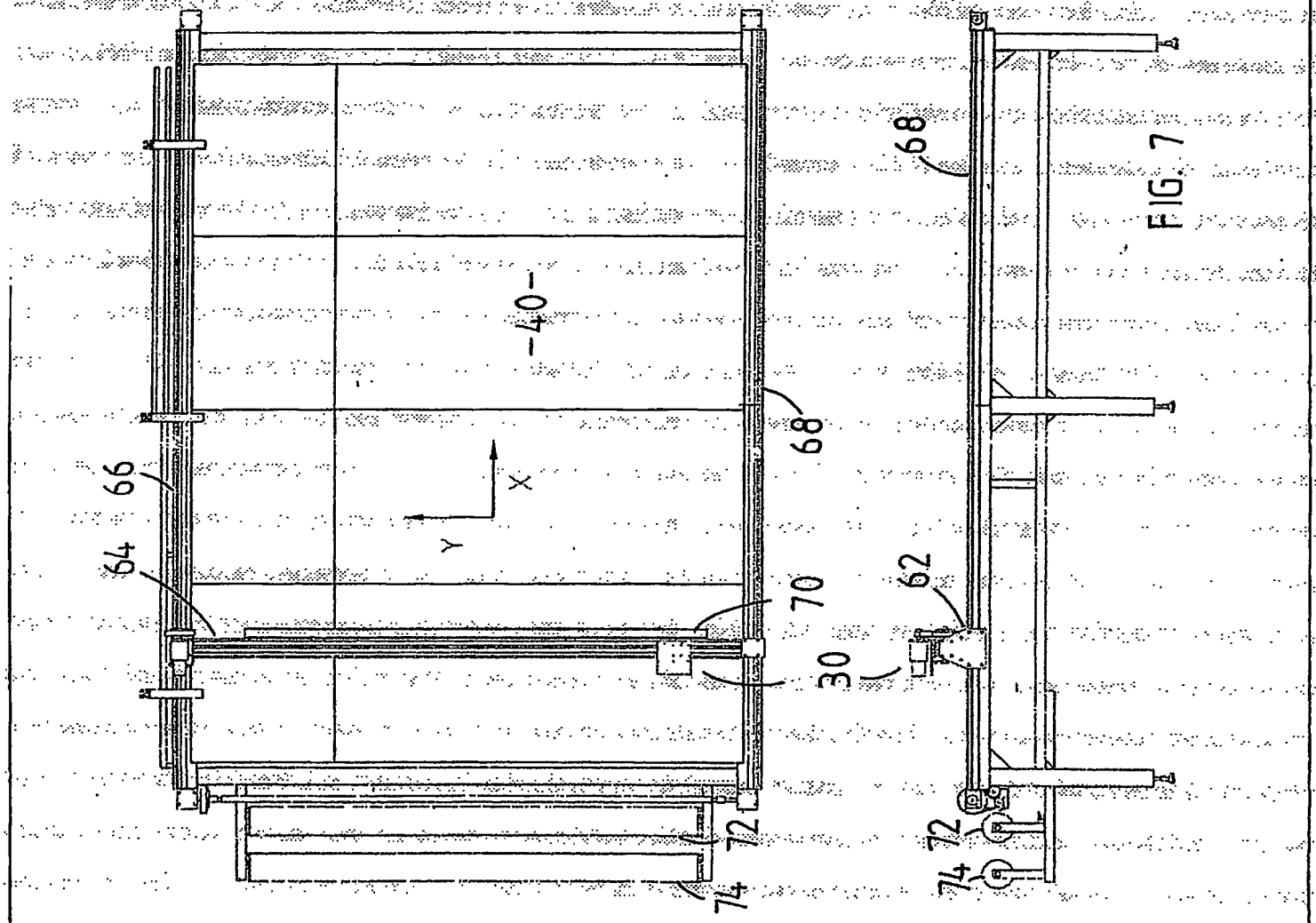

FIG. 7

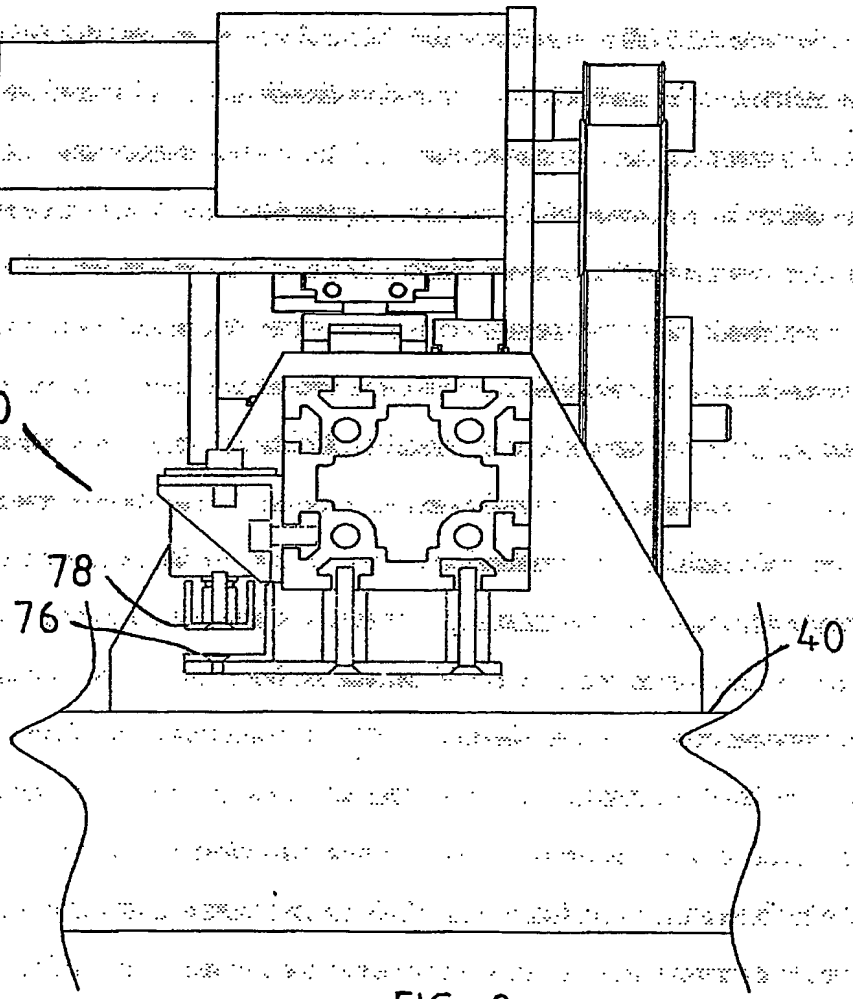

FIG. 8

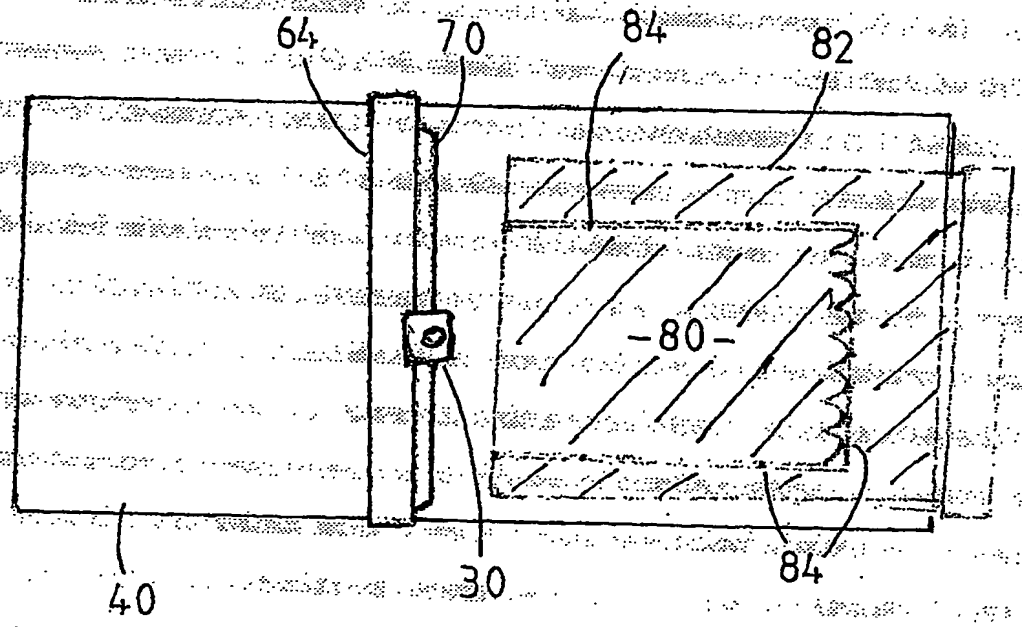

FIG. 9

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